SEQUENCE LISTING

(1) GENERAL INFORMATION:

    (i) APPLICANT: Weiner, David B.
                          Wang, Bin
                          Ugen, Kenneth E.

    (ii) TITLE OF INVENTION: Methods of Inducing Mucosal Immunity

    (iii) NUMBER OF SEQUENCES: 40

    (iv) CORRESPONDENCE ADDRESS:
        (A) ADDRESSEE: Woodcock Washburn Kurtz Mackiewicz & Norris
        (B) STREET: One Liberty Place 46th Floor
        (C) CITY: Philadelphia
        (D) STATE: Pennsylvania
        (E) COUNTRY: USA
        (F) ZIP: 19103

    (v) COMPUTER READABLE FORM:
        (A) MEDIUM TYPE: Floppy disk
        (B) COMPUTER: IBM PC compatible
        (C) OPERATING SYSTEM: PC-DOS/MS-DOS
        (D) SOFTWARE: WordPerfect 5.0

    (vi) CURRENT APPLICATION DATA:
        (A) APPLICATION NUMBER:
        (B) FILING DATE:
        (C) CLASSIFICATION:

    (vii) PRIOR APPLICATION DATA:
        (A) APPLICATION NUMBER:
        (B) FILING DATE:
        (C) CLASSIFICATION:

    (viii) ATTORNEY/AGENT INFORMATION:
        (A) NAME: DeLuca, Mark
        (B) REGISTRATION NUMBER: 33,229
        (C) REFERENCE/DOCKET NUMBER: UPAP-0114

    (ix) TELECOMMUNICATION INFORMATION:
        (A) TELEPHONE: 215-568-3100
        (B) TELEFAX: 215-568-3429

(2) INFORMATION FOR SEQ ID NO:1:

    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 32 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:1:

AGGCGTCTCG AGACAGAGGA GAGCAAGAAA TG   32

(2) INFORMATION FOR SEQ ID NO:2:

    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 30 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:2:

TTTCCCTCTA GATAAGCCAT CCAATCACAC   30

(2) INFORMATION FOR SEQ ID NO:3:
    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 27 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:3:

TTGTTTAACT TTTGATCGAT CCATTCC   27

(2) INFORMATION FOR SEQ ID NO:4:
    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 21 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:4:

GATTTGTATC GATGATCTGA C   21

(2) INFORMATION FOR SEQ ID NO:5:
    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 25 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:5:

TGTAGTAGCA AAAGAAATAG TTAAG   25

(2) INFORMATION FOR SEQ ID NO:6:
    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 25 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:6:

AATTCTTAAC TATTTCTTTT GCTAC   25

(2) INFORMATION FOR SEQ ID NO:7:
    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 40 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:7:

ATTTGTCGAC TGGTTTCAGC CTGCCATGGC AGGAAGAAGC   40

(2) INFORMATION FOR SEQ ID NO:8:
    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 29 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:8:

ACGACGCGTA TTCTTTAGCT CCTGACTCC   29

(2) INFORMATION FOR SEQ ID NO:9:

```
            (i) SEQUENCE CHARACTERISTICS:
                (A) LENGTH: 24 base pairs
                (B) TYPE: nucleic acid
                (C) STRANDEDNESS: single
                (D) TOPOLOGY: linear
            (ii) MOLECULE TYPE: DNA
            (xi) SEQUENCE DESCRIPTION: SEQ ID NO:9:
```

GCTGACGGTA GCGGCCGCAC AATT   24

```
    (2) INFORMATION FOR SEQ ID NO:10:
            (i) SEQUENCE CHARACTERISTICS:
                (A) LENGTH: 22 base pairs
                (B) TYPE: nucleic acid
                (C) STRANDEDNESS: single
                (D) TOPOLOGY: linear
            (ii) MOLECULE TYPE: DNA
            (xi) SEQUENCE DESCRIPTION: SEQ ID NO:10:
```

GTATTAAGCG GCCGCAATTG TT   22

```
    (2) INFORMATION FOR SEQ ID NO:11:
            (i) SEQUENCE CHARACTERISTICS:
                (A) LENGTH: 78 base pairs
                (B) TYPE: nucleic acid
                (C) STRANDEDNESS: single
                (D) TOPOLOGY: linear
            (ii) MOLECULE TYPE: DNA
            (xi) SEQUENCE DESCRIPTION: SEQ ID NO:11:
```

AAAAAGCTTC GCGGATCCGC GTTGCGGCCG CAACCGGTCA CCGGCGACGC GTCGGTCGAc   60

CGGTCATGGC TGGGCCCC   78

```
    (2) INFORMATION FOR SEQ ID NO:12:
            (i) SEQUENCE CHARACTERISTICS:
                (A) LENGTH: 29 base pairs
                (B) TYPE: nucleic acid
                (C) STRANDEDNESS: single
                (D) TOPOLOGY: linear
            (ii) MOLECULE TYPE: DNA
            (xi) SEQUENCE DESCRIPTION: SEQ ID NO:12:
```

CCCAAGCTTA GACATGATAA GATACATTG   29

```
    (2) INFORMATION FOR SEQ ID NO:13:
            (i) SEQUENCE CHARACTERISTICS:
                (A) LENGTH: 22 base pairs
                (B) TYPE: nucleic acid
                (C) STRANDEDNESS: single
                (D) TOPOLOGY: linear
            (ii) MOLECULE TYPE: DNA
            (xi) SEQUENCE DESCRIPTION: SEQ ID NO:13:
```

CTAGCAGCTG GATCCCAGCT TC   22

```
    (2) INFORMATION FOR SEQ ID NO:14:
            (i) SEQUENCE CHARACTERISTICS:
                (A) LENGTH: 24 base pairs
                (B) TYPE: nucleic acid
                (C) STRANDEDNESS: single
                (D) TOPOLOGY: linear
            (ii) MOLECULE TYPE: DNA
            (xi) SEQUENCE DESCRIPTION: SEQ ID NO:14:
```

GGATTTCTGG GGATCCAAGC TAGT   .   24

(2) INFORMATION FOR SEQ ID NO:15:
    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 31 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:15:

TATAGGATCC GCGCAATGAA AGACCCCACC T   31

(2) INFORMATION FOR SEQ ID NO:16:
    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 31 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:16:

ATATGGATCC GCAATGAAAG ACCCCCGCTG A   31

(2) INFORMATION FOR SEQ ID NO:17:
    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 30 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:17:

TAAAGCGGCC GCTCCTATGG CAGGAAGACG   30

(2) INFORMATION FOR SEQ ID NO:18:
    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 34 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:18:

ATTACGCGTC TTATGCTTCT AGCCAGGCAC AATG   34

(2) INFORMATION FOR SEQ ID NO:19:
    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 40 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:19:

ATTACGCGTT TATTACAGAA TGGAAAACAG ATGGCAGGTG   40

(2) INFORMATION FOR SEQ ID NO:20:
    (i) SEQUENCE CHARACTERISTICS:
        (A) LENGTH: 32 base pairs
        (B) TYPE: nucleic acid
        (C) STRANDEDNESS: single
        (D) TOPOLOGY: linear
    (ii) MOLECULE TYPE: DNA
    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:20:

ATTACGCGTT ATTGCAGAAT TCTTATTATG GC   32

(2) INFORMATION FOR SEQ ID NO:21:

                    (i) SEQUENCE CHARACTERISTICS:
                         (A) LENGTH: 38 base pairs
                         (B) TYPE: nucleic acid
                         (C) STRANDEDNESS: single
                         (D) TOPOLOGY: linear
                    (ii) MOLECULE TYPE: DNA
                    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:21:

GAGGCTTGGA GAGGATTATA GAAGTACTGC AAGAGCTG   38

(2) INFORMATION FOR SEQ ID NO:22:
          (i) SEQUENCE CHARACTERISTICS:
                         (A) LENGTH: 39 base pairs
                         (B) TYPE: nucleic acid
                         (C) STRANDEDNESS: single
                         (D) TOPOLOGY: linear
                    (ii) MOLECULE TYPE: DNA
                    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:22:

GAATCCTCTC CAAGCCTCAG CTACTGCTAT AGCTGTGGC   39

(2) INFORMATION FOR SEQ ID NO:23:
          (i) SEQUENCE CHARACTERISTICS:
                         (A) LENGTH: 39 base pairs
                         (B) TYPE: nucleic acid
                         (C) STRANDEDNESS: single
                         (D) TOPOLOGY: linear
                    (ii) MOLECULE TYPE: DNA
                    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:23:

AAAAATAAAG CGGCCGCTCC TATGGCAGGA AGAGAAGCG   39

(2) INFORMATION FOR SEQ ID NO:24:
          (i) SEQUENCE CHARACTERISTICS:
                         (A) LENGTH: 39 base pairs
                         (B) TYPE: nucleic acid
                         (C) STRANDEDNESS: single
                         (D) TOPOLOGY: linear
                    (ii) MOLECULE TYPE: DNA
                    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:24:

AAAAAATTAC GCGTCTTATG CTTCTAGCCA GGCACAATG   39

(2) INFORMATION FOR SEQ ID NO:25:
          (i) SEQUENCE CHARACTERISTICS:
                         (A) LENGTH: 31 base pairs
                         (B) TYPE: nucleic acid
                         (C) STRANDEDNESS: single
                         (D) TOPOLOGY: linear
                    (ii) MOLECULE TYPE: DNA
                    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:25:

CCCAAGCTTG GGAATGCTCT GCCAGTGTTA C   31

(2) INFORMATION FOR SEQ ID NO:26:
          (i) SEQUENCE CHARACTERISTICS:
                         (A) LENGTH: 36 base pairs
                         (B) TYPE: nucleic acid
                         (C) STRANDEDNESS: single
                         (D) TOPOLOGY: linear
                    (ii) MOLECULE TYPE: DNA
                    (xi) SEQUENCE DESCRIPTION: SEQ ID NO:26:

GGGGGCCGGA AGGGCACAAT AAAACTGTCT GCTTAC   36

(2) INFORMATION FOR SEQ ID NO:27:
          (i) SEQUENCE CHARACTERISTICS:

             (A) LENGTH: 33 base pairs
             (B) TYPE: nucleic acid
             (C) STRANDEDNESS: single
             (D) TOPOLOGY: linear
       (ii) MOLECULE TYPE: DNA
       (xi) SEQUENCE DESCRIPTION: SEQ ID NO:27:

CCTGATTCAG GTGAAAATAT TGTTGATGCG CTG   33

(2) INFORMATION FOR SEQ ID NO:28:
      (i) SEQUENCE CHARACTERISTICS:
             (A) LENGTH: 111 base pairs
             (B) TYPE: nucleic acid
             (C) STRANDEDNESS: single
             (D) TOPOLOGY: linear
       (ii) MOLECULE TYPE: DNA
       (xi) SEQUENCE DESCRIPTION: SEQ ID NO:28:

AACATCAATA CAACCTATTA ATTTCCCCTC GTCAAAAATA AGGTTATCAA GTGAGAAATC   60

ACCATCAGTG ACGACTGAAT CCGGTGAGAA TGGCAAAAGT TTATGCATTT C   111

(2) INFORMATION FOR SEQ ID NO:29:
      (i) SEQUENCE CHARACTERISTICS:
             (A) LENGTH: 55 base pairs
             (B) TYPE: nucleic acid
             (C) STRANDEDNESS: single
             (D) TOPOLOGY: linear
       (ii) MOLECULE TYPE: DNA
       (xi) SEQUENCE DESCRIPTION: SEQ ID NO:29:

CTAGCGCGGG GATCCGCGTT GCGGCCGCAA AAAGTCGACG GGCGACGCGT AAAAA   55

(2) INFORMATION FOR SEQ ID NO:30:
      (i) SEQUENCE CHARACTERISTICS:
             (A) LENGTH: 55 base pairs
             (B) TYPE: nucleic acid
             (C) STRANDEDNESS: single
             (D) TOPOLOGY: linear
       (ii) MOLECULE TYPE: DNA
       (xi) SEQUENCE DESCRIPTION: SEQ ID NO:30:

GATCTTTTTA CGCGTCGCCC GTCGACTTTT TGCGGCCGCA ACGCGGATCC CCGCG   55

(2) INFORMATION FOR SEQ ID NO:31:
      (i) SEQUENCE CHARACTERISTICS:
             (A) LENGTH: 48 base pairs
             (B) TYPE: nucleic acid
             (C) STRANDEDNESS: single
             (D) TOPOLOGY: linear
       (ii) MOLECULE TYPE: DNA
       (xi) SEQUENCE DESCRIPTION: SEQ ID NO:31:

ATGTCGACTG GTTTCAGCCT GCCATGGCAG GAAGAAGC   48

(2) INFORMATION FOR SEQ ID NO:32:
      (i) SEQUENCE CHARACTERISTICS:
             (A) LENGTH: 35 base pairs
             (B) TYPE: nucleic acid
             (C) STRANDEDNESS: single
             (D) TOPOLOGY: linear
       (ii) MOLECULE TYPE: DNA
       (xi) SEQUENCE DESCRIPTION: SEQ ID NO:32:

CCCCACGACG CGTCTATTCT TTAGCTCCTG ACTCC   35

(2) INFORMATION FOR SEQ ID NO:33:

```
        (i) SEQUENCE CHARACTERISTICS:
            (A) LENGTH:   35 base pairs
            (B) TYPE: nucleic acid
            (C) STRANDEDNESS: single
            (D) TOPOLOGY: linear
       (ii) MOLECULE TYPE: DNA
       (xi) SEQUENCE DESCRIPTION: SEQ ID NO:33:
```

TTTGCGGCCG CGTAAGTGGA GAGAGATGGT GCGAG   35

```
(2) INFORMATION FOR SEQ ID NO:34:
        (i) SEQUENCE CHARACTERISTICS:
            (A) LENGTH:   21 base pairs
            (B) TYPE: nucleic acid
            (C) STRANDEDNESS: single
            (D) TOPOLOGY: linear
       (ii) MOLECULE TYPE: DNA
       (xi) SEQUENCE DESCRIPTION: SEQ ID NO:34:
```

CTGGTGGGGC TGTTGGCTCT G   21

```
(2) INFORMATION FOR SEQ ID NO:35:
        (i) SEQUENCE CHARACTERISTICS:
            (A) LENGTH:   80 base pairs
            (B) TYPE: nucleic acid
            (C) STRANDEDNESS: single
            (D) TOPOLOGY: linear
       (ii) MOLECULE TYPE: DNA
       (xi) SEQUENCE DESCRIPTION: SEQ ID NO:35:
```

AATTTAATAA GTAAGTAAGT GTCATATGTT TGTTTGAATT CTGCAACAAC TGCTGTTTAT   60

CCATTTTCAG AATTGGGTG   80

```
(2) INFORMATION FOR SEQ ID NO:36:
        (i) SEQUENCE CHARACTERISTICS:
            (A) LENGTH:   80 base pairs
            (B) TYPE: nucleic acid
            (C) STRANDEDNESS: single
            (D) TOPOLOGY: linear
       (ii) MOLECULE TYPE: DNA
       (xi) SEQUENCE DESCRIPTION: SEQ ID NO:36:
```

TCGACACCCA ATTCTGAAAA TGGATAAACA GCACTTGTTG CAGAATTCAA ACAAACATAT   60

GACACTTACT TACTTATTA   80

```
(2) INFORMATION FOR SEQ ID NO:37:
        (i) SEQUENCE CHARACTERISTICS:
            (A) LENGTH:   41 base pairs
            (B) TYPE: nucleic acid
            (C) STRANDEDNESS: single
            (D) TOPOLOGY: linear
       (ii) MOLECULE TYPE: DNA
       (xi) SEQUENCE DESCRIPTION: SEQ ID NO:37:
```

GGGGTTTTTG GGCATATGTA TGAGGGACAA TTGGAGAAGT G   41

```
(2) INFORMATION FOR SEQ ID NO:38:
        (i) SEQUENCE CHARACTERISTICS:
            (A) LENGTH:   70 base pairs
            (B) TYPE: nucleic acid
            (C) STRANDEDNESS: single
            (D) TOPOLOGY: linear
       (ii) MOLECULE TYPE: DNA
       (xi) SEQUENCE DESCRIPTION: SEQ ID NO:38:
```

AAGCTTGTGG AATTCTTAAT TTCTCTGTCC GGGGTTTTTG GGCATATGTA TGAGGGACAT   60

TGGAGAAGTG   70

(2) INFORMATION FOR SEQ ID NO:39:
       (i) SEQUENCE CHARACTERISTICS:
              (A) LENGTH: 29 base pairs
              (B) TYPE: nucleic acid
              (C) STRANDEDNESS: single
              (D) TOPOLOGY: linear
      (ii) MOLECULE TYPE: DNA
      (xi) SEQUENCE DESCRIPTION: SEQ ID NO:39:

CAGTATCTGG CATGGGTAC   29

(2) INFORMATION FOR SEQ ID NO:40:
       (i) SEQUENCE CHARACTERISTICS:
              (A) LENGTH: 29 base pairs
              (B) TYPE: nucleic acid
              (C) STRANDEDNESS: single
              (D) TOPOLOGY: linear
      (ii) MOLECULE TYPE: DNA
      (xi) SEQUENCE DESCRIPTION: SEQ ID NO:40:

CCATGCCAGA TACTGGTAC   29